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Effect of soil amendments for remediation and revitalization of leached chernozem contaminated by tridecane

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Abstract

At contaminated sites, soil amendments can be used to solve two main problems: contaminant bio- and phytoavailability and poor soil health and ecosystem functions. Applied properly, they improve many characteristics of a contaminated soil, first of all physical-chemical properties and microbial activity and therefore allow both enhancing biodegradation and restoring soil quality (EPA, 2007). Soil amendments can be used for biostimulation to address as inorganic as organic contaminants but at present the first ones are studied more detailed. In a green-scale experiment in plastic 1.5 kg pots (soil moisture 60% of water holding capacity), the effects of two soil amendments introduced into the soil conta-minated by n-tridecane (TD, 1 wt.%), a typical fuel hydrocarbon, were studied and compared. As soil, heavy loam leached chernozem (pH, 5.2; Corg., 3.7%; Ntotal, 0.3%) located in Tatarstan which is one of the main oil recovery and refinery regions in Russia was studied. As a nitrogen fertilizer, ammonium nitrate (Na, 0.3 g N/kg of soil) and as a bulking agent, the local zeolite-containing material of Tatarsko-Shatrashansky deposit (ZCM, 50 g/ kg of soil, clinoptilolite/heulandite, 12%; smectite, 20%; calcite, 18%; generally used for soil amelioration) were used. The treatments of the experiment were formed as uncontaminated soil (0; +Na; +ZCM) and soil contaminated with n-tridecane (1%TD; N+1%TD; ZCM+1%TD). After 48 days of the experiment, in all treatments the influence of soil amendments on soil properties (pH; microbial enumeration of tridecane degraders; basal, Vbasal and substrate-induced, Vsir respiration; microbial respiration quotient, QR) and the residual content of tridecane in the soil (GC-FID analysis), were evaluated. After the experiment was completed, the results were generalized on two factors: (i) the effects of tridecane contamination on soil characteristics: (Soil+TD)/Soil, or (Soil+TD+amendment)/(Soil+amendment) (ii) the effects of ZCM and Na additives on soil characteristics: (Soil+amendment)/ Soil, or (Soil+TD+amendment)/(Soil+TD). It should be noted that according to the data early obtained in our laboratory, the studied leached chernozem was characterized by comparatively high biodegradation ability in regard to petroleum products (Breus et al, 2005). Comparison showed that among two additives, Na considerably stimulated soil microbial activity regarding all studied parameters (Vbasal, Vsir, and QR). Na has led C/N ratio in the contaminated soil practically up to the optimal level and provided the greatest rate of tridecane degradation in leached chernozem. Opposite, the positive influence of ZCM on both Vbasal and Vsir in the contaminated soil was less essential and tridecane degradation even decreased in comparison to soil without additives. In our opinion, the main reason for that was keeping a part of hydrocarbon within the pore structure of ZCM which reduced the availability of tridecane to biodegradation and also disturbed soil water and air regime. In the report, the

quantified effects of both soil amendments will be presented.